

FEASIBILITY STUDY
OF SMALL COMPUTER APPLICATION
OF MULTI-TRADE SCHEDULING

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FINAL REPORT

FOR

FEASIBILITY STUDY OF SMALL COMPUTER APPLICATION
TO MULTI-TRADE SCHEDULING OF A REPAIR DEPARTMENT

TO

SNAME/SHIP PRODUCTION
PANEL SP-8 INDUSTRIAL
ENGINEERING

JULY 16, 1986

BY:

NATIONAL STEEL AND SHIPBUILDING COMPANY
HARBOR DRIVE AND 28TH STREET
SAN DIEGO, CA. 92138

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM
THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
SHIP PRODUCTION COMMITTEE
PANEL SP-8
SHIPYARD INDUSTRIAL ENGINEERING

FEASIBILITY STUDY OF SMALL COMPUTER APPLICATION
OF MULTI-TRADE SCHEDULING

FIINAL REPORT

TASK ES-8-27

Submitted to:

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Date: July, 1986

This project is managed and cost-shared by National Steel and Shipbuilding Company for the National Shipbuilding Research Program. The program is a cooperative effort of the Maritime Administration's Office of Advanced Ship Development, the U.S. Navy, the U.S. shipbuilding industry, and selected academic institutions.

The Shipbuilding and Repair Industry has long stressed the need for planning and scheduling. Organizations and systems dedicated to this end vary greatly from yard to yard depending upon size, complexity of ship(s), and even customer requirements.

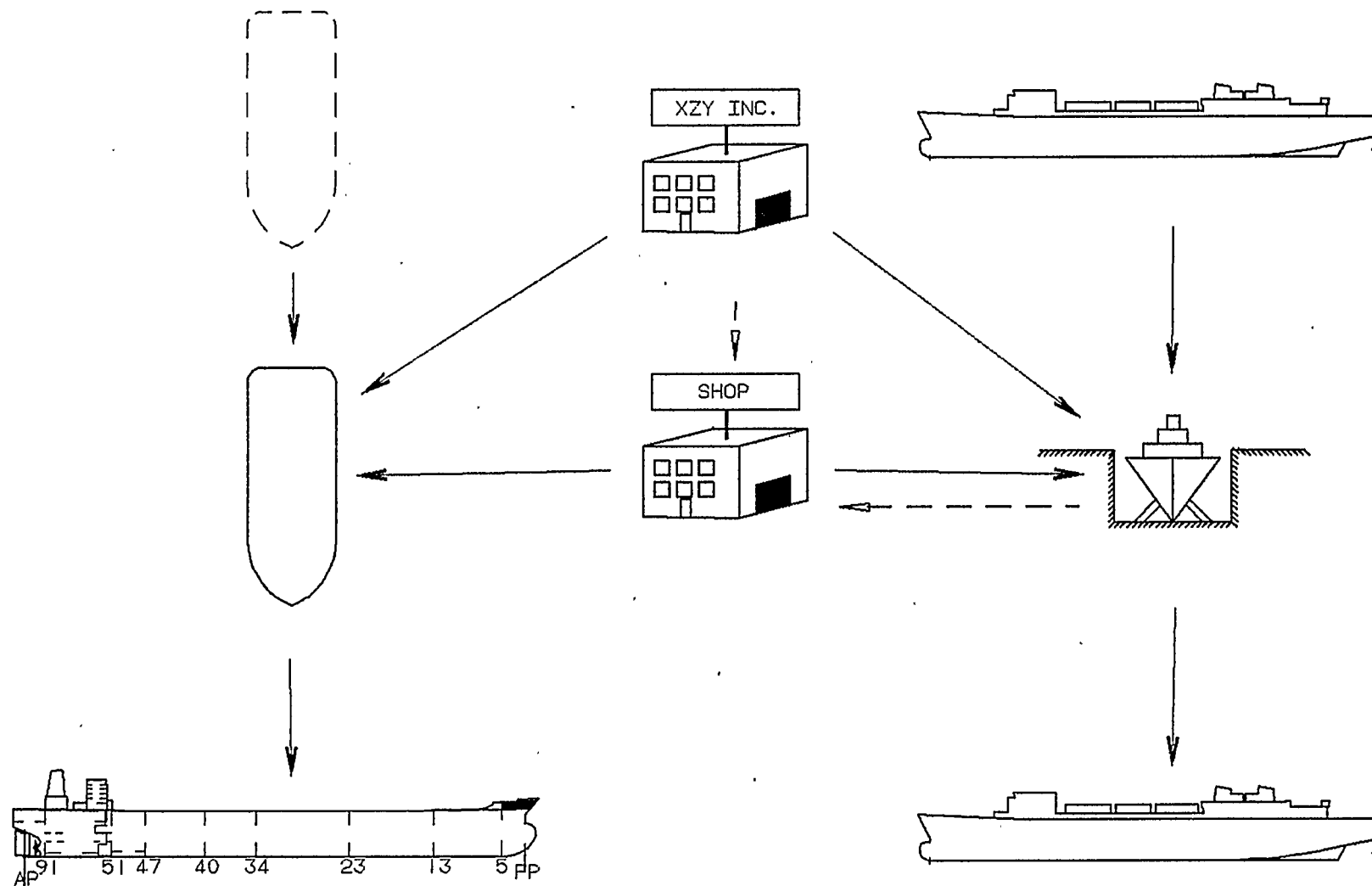
This feasibility study is based upon the belief that most yards have highly developed systems for ship construction and ship repair, utilizing main frame hardware and software. These systems are based on yard wide Master Schedules and are oriented to individual ship requirements, therefore, leaving interfacing of multi-ship scheduling to department level solutions.

Most trade departments of most yards have solved these Master Scheduling system voids with manual paper work methods, which result in laborious, tedious and tardy data and reports. Man power planning and forecasting is guess work, and emergent work scheduling is managed by crisis. The small computer has reached a very high level of sophistication, but has not yet been fit into the department level, complete with yard wide system interface.

Futher to these points refer to exhibits I thru III. The classic flow (exhibit I) differences between shipbuilding and ship repair do not greatly alter the shop trade scheduling objectives and controls. However, overall management is conducted by ship (exhibit II) leaving shop management the problem of integrated item scheduling. The shop management can best be accomplished thru item priorities rather than ship priorities (exhibit III) and a sound system must be in place in order to provide adequate scheduling and control.

SHIPBUILDING

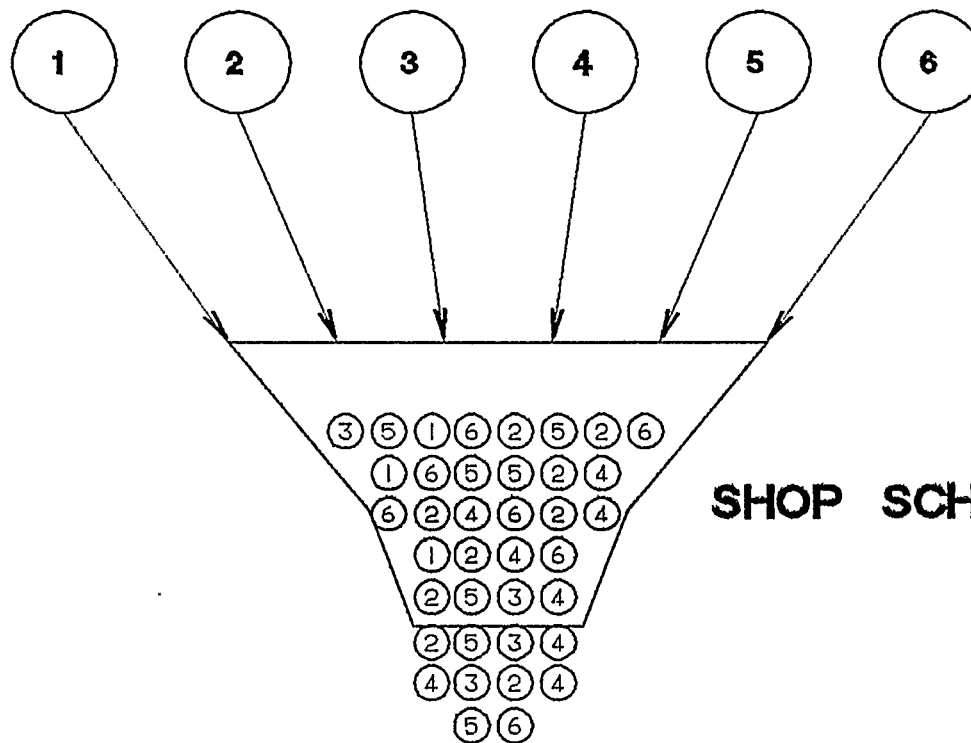
SHIP REPAIR



SHIP MANAGEMENT

	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

SHIP SCHEDULING



SHOP SCHEDULING

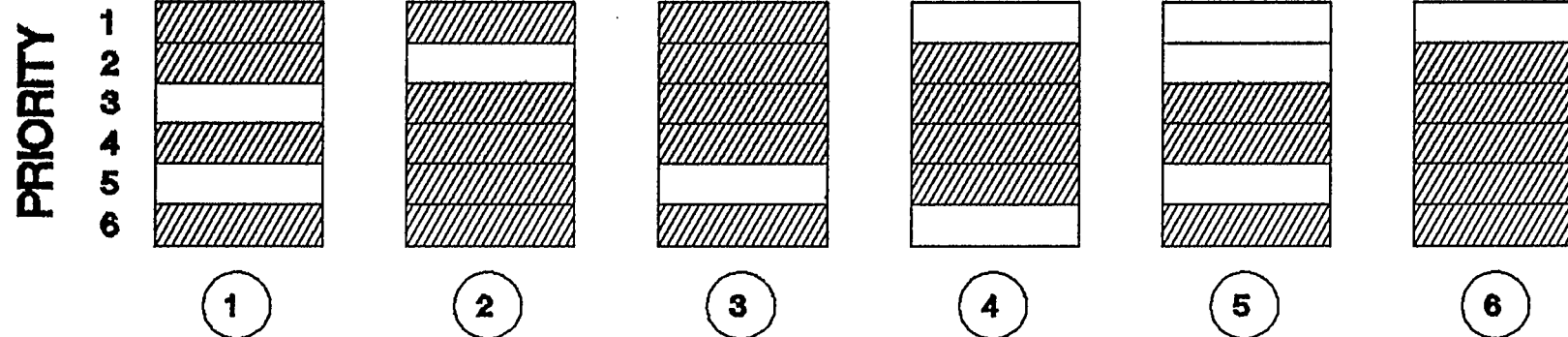


EXHIBIT III

The technical objective of the study was to determine the feasibility of developing a scheduling system that will provide a Multi-Trade Repair Department* with: (1) Man power planning; (2) Critical job scheduling; (3) Sub-job item control; and (4) Purchase parts interface to schedule. The study would review small computer hardware, off shelf software, custom program software, and over all cost parameters.

The ultimate system will be basically universally applicable, and have interface capability to other computers including main frame type.

- * - We found that a Multi-Trade (or even Single-Trade) Production Department, as well as a Repair Department, can benefit well from the results of the study and therefore we stress this broader scope at the outset.

The study consists of the following:

1. Model Preparation

Through interviews with department management, planners and schedulers, we were able to document specific requirements and problems. These were generalized in order to create a model which would be as universal as possible.

2. Model Parameters

Here, we quantified record sizes and computer processing demands to permit determination of small computer hardware and software compatibility to the model.

3. Computer Application

We investigated state-of-the-art small computer hardware and software to solve the model parameters, and develop generally applicable systems criteria that would pinpoint limitations, potential results, support requirements, and costs.

4. Conclusions

We believe the study is conclusive and does offer potential for a majority of shipyards. Small computers do offer ultimate system applications capable of man power planning, critical job scheduling, and main frame interface.

The Model

Our study resulted in a model (greatly simplified) containing the essentials of any yard scheduling task.

- 0 Labor
 - 0 Material
 - 0 Specifications
 - 0 Outside Services
- (Please refer to the exhibits IV thru XI.)

It is recognized that an activity with machine capacity limitations would require consideration, possibly as a fifth factor or as part of, or a substitute for, labor.

The model (exhibit IV) is based on identified and emergent work requirements.

- 0 Identified work is planned work. (exhibit V)
 - 0 Master yard schedule
 - 0 Work package(s)
 - 0 Contract package
 - 0 Customer order
 - 0 Etc.
- 0 Emergent work (exhibit V) is unplanned work; generally unidentified until determined in the course of other work.
 - 0 Dimensional differences
 - 0 Component differences
 - 0 Material differences
 - 0 Rework
 - 0 "Open and Inspect" orders
 - 0 Work support, e.g., tooling
 - 0 Etc.

System Inputs and Outputs

The model assumes that system inputs can be of any source, from a main frame computer master plan (probably a work package) to a hand written work or service request. Further input details must be made as follows:

- 0 Item coding (identification)
- 0 Labor standards or estimates
- 0 Work routing
- 0 Material specifications
- 0 Purchasing information
- 0 Engineering, specification, and change order data
- 0 (And so on, depending on the system specifics)
- 0 Job Completion or Need Date

System outputs are invisioned in the form of CRT readouts in the "working mode" and printouts for the "history or report mode". We see the following as a partial list of outputs:

- 0 Job and\or Material Status
- 0 Job and/or Material Late/Due
- 0 Manpower/Load Analysis
- 0 Change order status
- 0 Rejection status

The possibilities here are infinite and the objectives of a specific application will determine the planned outputs.

One operating model flow is charted in exhibit X. The order is processed completely thru all phases of planning and shop action including maierials requisitioning. The record file (master) is constantly up dated throughout the cycle and "real time" analyses and action reports are generated.

An overview of the ideal small computer input and output flow (exhibit XI) summarizes what we hoped to accomplish in this feasibility study.

FEASIBILITY STUDY OF SMALL COMPUTERS

APPLICATION MODEL

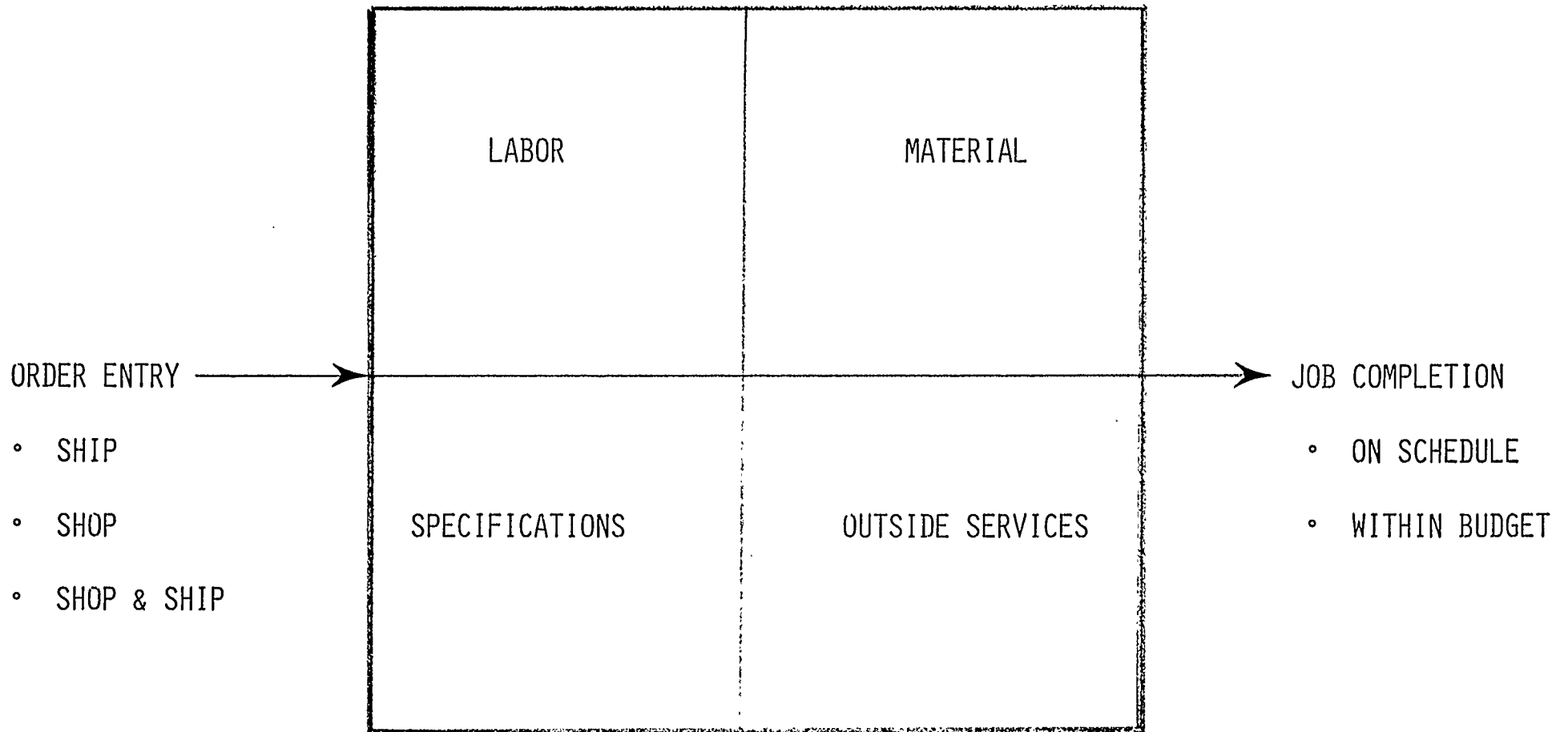


EXHIBIT IV

TYPE OF WORK

IDENTIFIED / EMERGENT

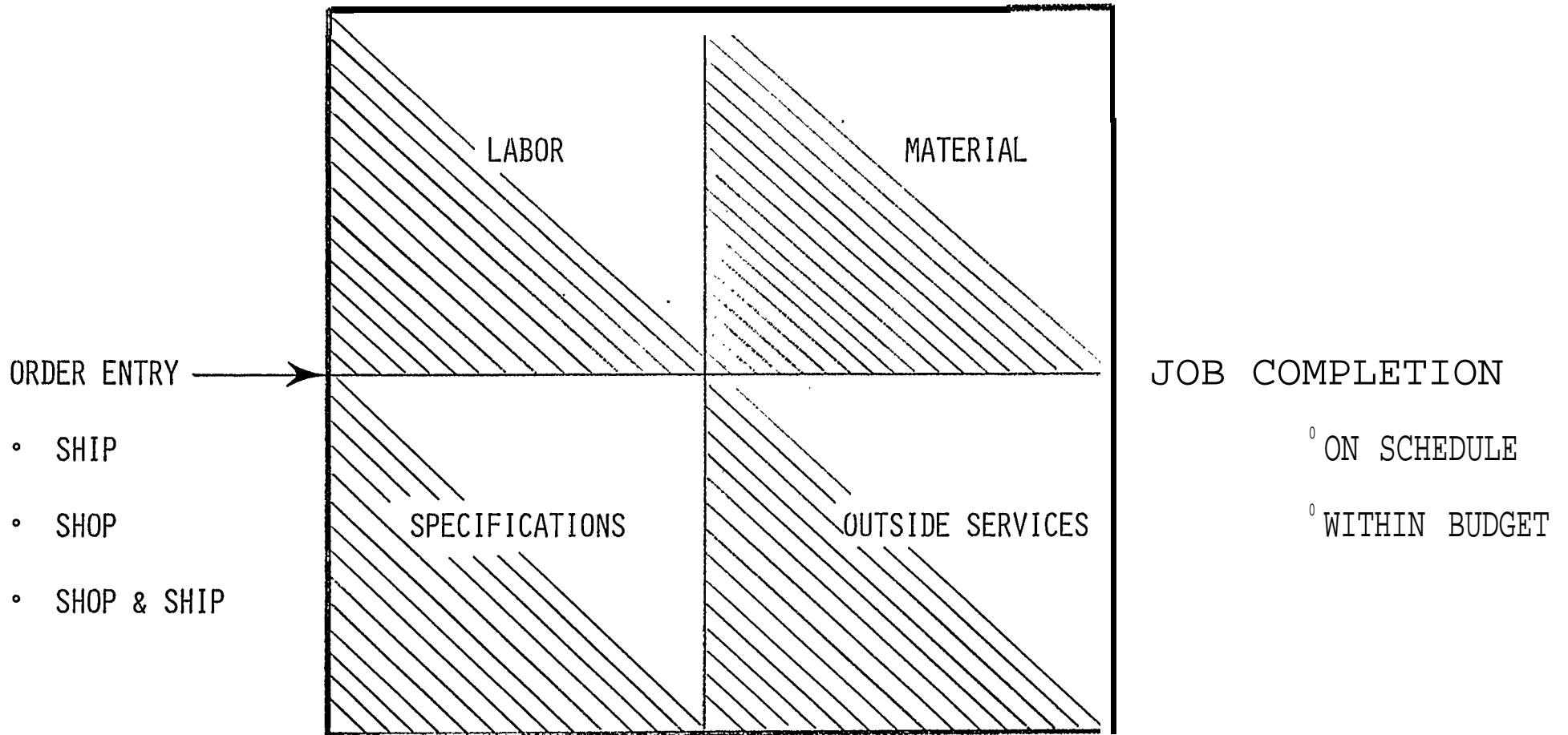


EXHIBIT V

OUTSIDE SERVICES

- PLANNING
- REQUISITION
- PURCHASE ORDER
- SERVICE RECEIVED

EXHIBIT VI

SPECIFICATIONS

°REQUIREMENTS

° CHANGE ORDERS

EXHIBIT VII

MATERIAL REQUIREMENTS

° PLANNING

° ESTABLISH MATERIALS

° REQUISITION

° PURCHASE ORDERS

° MATERIAL RECIEVED

EXHIBIT VIII

LABOR REQUIREMENTS

⁰ PLANNING

⁰ ESTABLISH COMPLETION DATE

⁰ DETERMINE START DATE

⁰ ESTABLISH TOTAL HOURS REQUIRED

⁰ DETERMINE TRADE MANNING

⁰ ESTABLISH SYSTEM LOAD

EXHIBIT IX

NASSCO

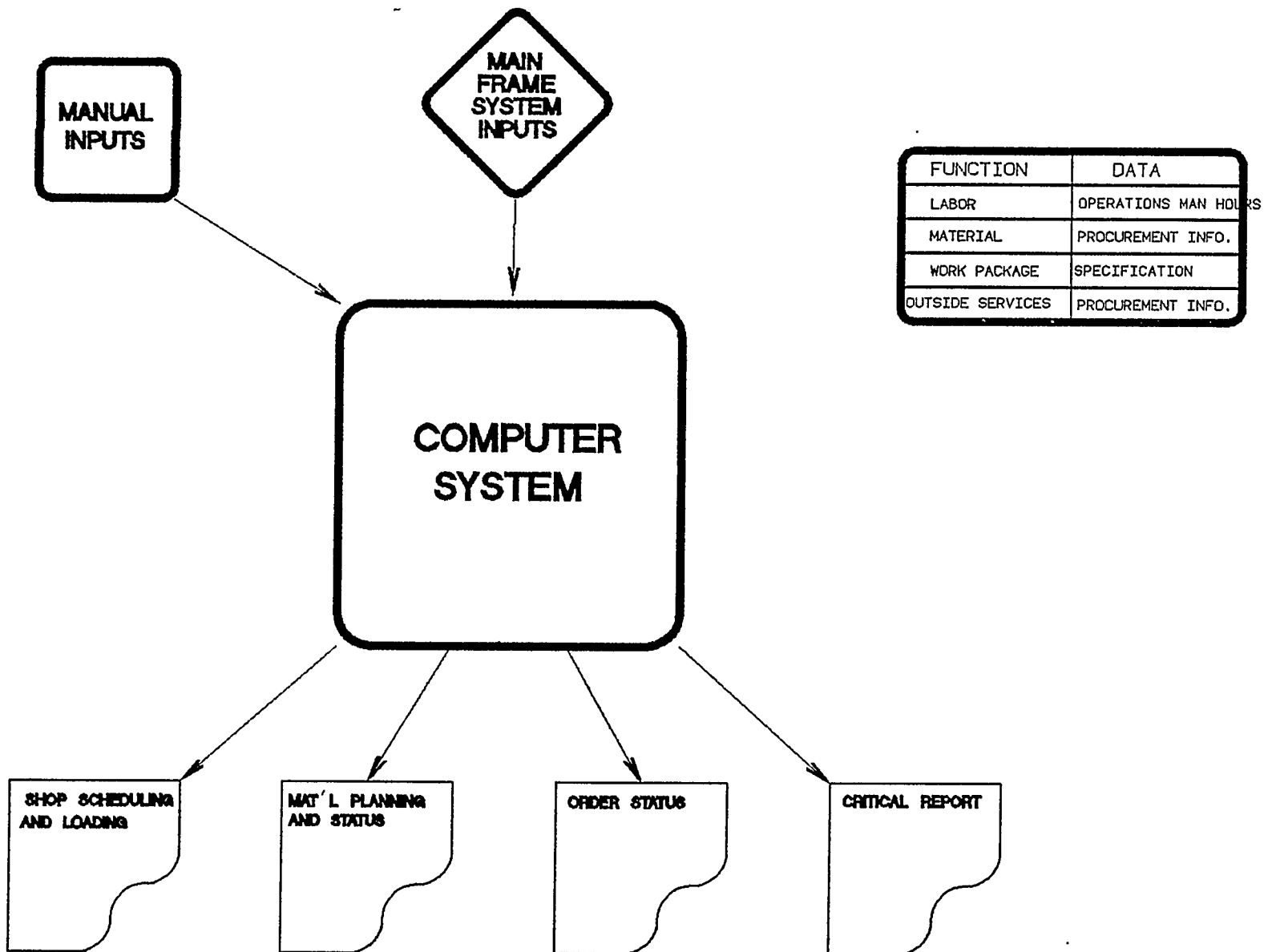
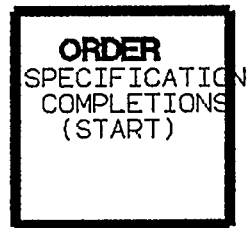


EXHIBIT X



START DATE
COMPLETION DATE
WORK CONTENT

SCHEDULE
REQUIREMENT

SUB ORDER ITEMS
LEAD TIME TO COMPLETION DATE
(OR NEED DATE)

BREAK DOWN
REQUIREMENTS

DETAILED WORK ANALYSIS BY ITEM
LABOR ESTIMATES (OR STANDARDS)
MATERIAL REQ.

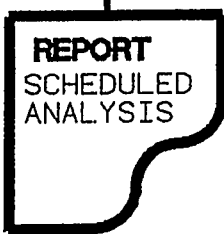
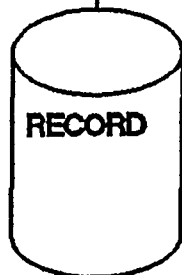
WORK
PLAN

PRODUCT OF WORK PLAN

LABOR
REQUIRED

PRODUCT OF BREAK DOWN
AND
WORKPLAN

MATERIAL
REQUIRED



Small Computer Analysis

The second major phase of the feasibility study was the hardware/software analysis.

We could not be exhaustive due to the project scope and therefore we tried to strike at the heart of the state-of-the-art, so to speak.

Limitations were required in terms of the systems capacities. We assumed 5000 records and 8000 bytes per record maximum(s). This equates to 40 mega bytes.

Mr. Javier Islas, an accountant and computer applications engineer, analyzed various aspects of the requirements and made the following recommendations:

- 0 Small (personal) computer hardware, utilizing off-the-shelf software and custom program software are capable and available for use in a scheduling system that will provide a Multi-Trade Repair Department with (1) man power planning, (2) critical job scheduling, (3) sub-job item control, and (4) purchase parts interface. The critical area will be centered around defining project parameters with regard to data size focusing on constraints and limitations.
- 0 The system capacity can be broken down into two elements. The first has to do with the total number of records (distinct items); the second with the field (item data); i.e., specifications, size and its relationship with the CRT (monitor/screen) .

A record size should be kept at a maximum of 8,000 bytes with 100 fields of 80 columns each. These considerations are within the constraints found in long standing proven software.

- 0 The software considerations should focus on those off-the-shelf products which are considered the "standard" in the industry. The off-the-shelf software (because of performance software support and updates) would be those which handle Data Management, Project Management and micro-to-mainframe communication (IRMA).

The Data Management software system considered the "standard" software in the personal computer industry is dBASE III Plus. It provides data storage and retrieval, with or without knowledge of the system programming language, in an easy and efficient manner with an additional broad range of applications. The system requires IBM PC/XT or AT and/or compatible hardware with at least 384 KB RAM. In addition, the record size is limited to 4,000 bytes, and the field size is limited to 128 fields.

The Project Management software system considered the leader, if not the "standard", in the personal computer industry is Super Project-Plus. It provides project planning, scheduling and budgeting in a flexible system with many visual features. The system requires IBM PC/XT or AT or compatible hardware with at least 320 KB RAM. In addition, the task size should be kept at 420 bytes for average projects with three assignments linked for each task.

The Communication software and hardware system for micro-to-mainframe link for IBM PC, PC/XT, or PC/AT is called IRMA. This communication link is considered the standard in the personal computer industry. It is capable of Terminal Emulation as well as file transfer utilities. The system requires minimal RAM and can be used in either resident or non-resident mode.

In addition, more and more customized software programs are being designed with such flexibility that they should also be monitored.

- 0 The "standard" software and most custom software manufacturers have focused their research and development with the hardware considered the "standard" of the personal computer industry, which has been IBM for some time now. The hardware has continued to improve over the years and the market place has become very competitive which has decreased cost to lower and lower levels.

If costs are extremely critical to the operation and justification, then we should consider IBM compatibles (clones). These machines have been performing well, but require in-house expertise versus vendor support for IBM's. Please see exhibit XII, indicating prices of the major components needed.

- 0 In addition to the hardware, we should consider the input cost in order to analyze the cost versus benefits. This cost is directly related to the size of the data and can be estimated using key stroke data entry standard estimating techniques. At the maximum capacities of the software it would require approximately 500 to 600 hours.

Exhibit-XII, Summary of Basic Personal Computer System Cost

<u>Item Description</u>	<u>IBM</u>	<u>IBM Compatible</u>
<u>Hardware</u>		
CPU with Hard Disk	\$3,500	\$2,000
Color Monitor	500	300
Dot Matrix Printer	1,000	500
Communication Interface (including software)	<u>1,000</u>	<u>700</u>
SUB-TOTAL	<u>\$6,000</u>	<u>\$3,500</u>
<u>Software</u>		
Data Management	\$ 600	\$ 350
Project Management	<u>600</u>	<u>350</u>
SUB-TOTAL	<u>\$1,200</u>	<u>\$ 700</u>
TOTAL ESTIMATE	<u><u>\$7,200</u></u>	<u><u>\$4,200</u></u>
<u>Other</u>		
	<u>Est. cost</u>	
Maintenance	<u>\$ 200</u> per month	
Equipment Lease	<u>\$ 500</u> per month	

Model Vs. Computer System(s)

Based upon the foregoing recommendations we studied the software in order to make specific "linkage" to the model.

We see the linking as follows:

<u>Software Description</u>	<u>Model Function</u>
1. dBASE III plus	0 Order Entry Master File 0 Labor File 0 Material File 0 Specifications File 0 Services File 0 Hours, Trade Manning, and Load Analysis 0 All Systems Reports
2. Super Project-Plus	0 Planning Analysis 0 Critical Path Schedules 0 Start Date Determinations
3. IRMA	0 Down Loading From Mainframe Files 0 Up Loading Possible

May we stress that this study in no way should limit the system application to I.B.M. PC's or the software used as examples. For example, the Apple Macintosh is a very fine and powerful PC and software is unlimited. What has been accomplished is this:

1. THERE IS SYSTEMS NEED.
2. THE SMALL COMPUTER IS CAPABLE OF DOING THE WORK.
3. SOFTWARE IS AVAILABLE.
4. THE COST IS REASONABLE.
5. A SYSTEM APPLICATION WILL REQUIRE SPECIFIC DESIGN AND CERTAIN SPECIAL PROGRAMMING.

The next step in this process should be an actual application.

Such a project would require in-depth model and systems detail, not possible in this feasibility study; actual small computer hardware and software determination and acquisition; and a sufficient period for development, start-up, and on going operation.